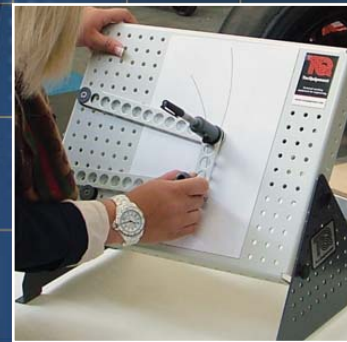


# Engineering Science

Engineering Science Work Panel	9
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1

Engineering Science



“ I am very pleased to find the highly innovative and professional approach of TecEquipment Ltd in designing and manufacturing a variety of equipment for engineering and technical education at all levels. Such equipment is very useful to develop conceptual skills in students. ”

**Dr Ing V P Singh, Principal, Shri Vaishanv Institute of Technology and Science, Indore, India**

# Engineering Science

The Engineering Science (ES) range of products is a system of experiment kits that covers many of the underlying mechanical engineering topics that students need to be familiar with, including:

- **Materials testing**
- **Vibration**
- **Mechanisms**
- **Forces and moments**
- **Simple machines**
- **Friction**

The system is suitable for use on courses from foundation level up to hands-on technology familiarisation programmes at post-graduate level.

The kits are high quality, robust, very visual and meant for hands-on learning. They can be used to make the vital link between theory and real systems and practical applications.

This is a modular system based around a robust, reusable work panel onto which students set up and perform their experiments. This means you can order as much or as little as you like, and a comprehensive system can be built up over a period of time.

Ideal for curricula based on educating students in four specific disciplines –

**science, technology, engineering and mathematics** – in colleges and schools. The ES

range, with its hands-on approach and detailed notes on experiments, provides the perfect link between theory and real-world applications.

TecQuipment's Engineering Science range is the foundation of STEM education.



## Comprehensive experiment kits

- Each kit offers multiple experiments – with over 60 experiments for the 18 kits, it is outstanding value for money.
- All the kits are safe and simple to use – ideal for minimal supervision at many levels of education.

## Long-lasting work panel

- Rugged, compact and easy to use – the Engineering Science work panel comes with over 1000 pages of worksheets, notes and lecturer material in PDF format.

## Convenient storage

- Kits are housed in tough, stackable trays.
- A purpose-built mobile storage unit offers you the flexibility to expand your range.

## Flexible ordering

- Start with one panel and one experiment, a bundle or buy the whole range – TecQuipment's Engineering Science range can be completely tailored to your needs and budget.



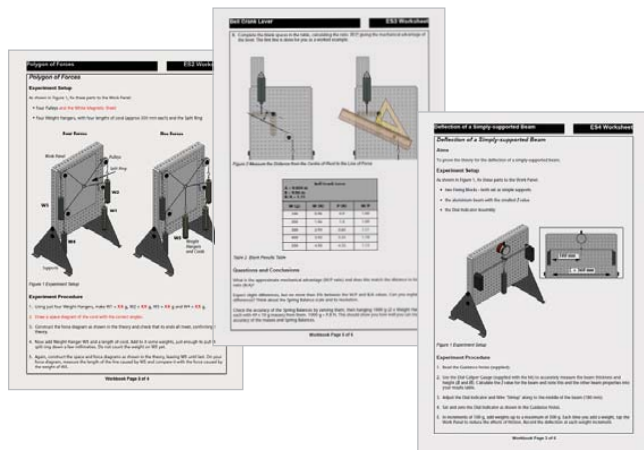


## The Engineering Science Work Panel (ES1)



Sturdy legs can be moved to orientate the work panel to portrait, landscape, flat or angled

Teaching material for all the experiments in the range is on a CD-ROM



## The Experiment Kits (ES2–ES19)

Code	Experiment Kit	Page
ES2	Forces Kit	10
ES3	Moments Kit	11
ES4	Deflection of Beams Kit	12
ES5	Torsion of Circular Sections Kit	13
ES6	Tensile Tester Kit	14
ES7	Simple Harmonic Motion Kit	15
ES8	Friction and Inclined Plane Kit	16
ES9	Potential and Kinetic Energy Kit	17
ES10	Pulley Kit	18
ES11	Drive Systems Kit	19
ES12	Cam, Crank and Toggle Kit	20
ES13	Gear Trains Kit	21
ES14	Simple Mechanisms Kit	22
ES15	Bar Linkages Kit	23
ES16	Centrifugal Force Kit	24
ES17	Rotational Friction Kit	25
ES18	Additional Mechanisms Kit	26
ES19	Spring Tester Kit	27

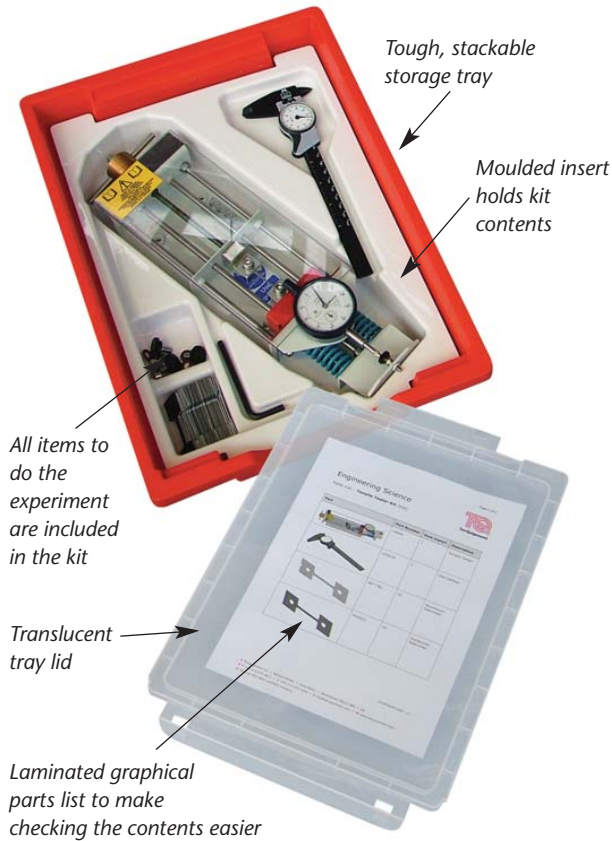


Pulley Kit (ES10) shown fitted to the work panel

## Storage Options

Each kit comes in a stackable tray – a simple solution when there is a small number of kits in a fixed location.

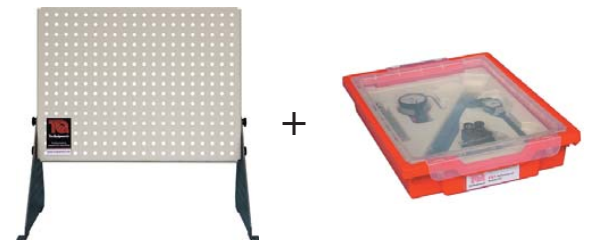
However, TecQuipment offers a purpose-built wheeled storage unit (EST) which can house all of the kits with room for duplication and expansion. This allows the kits to be easily stored beneath a worktop or counter in the lab, or moved in and out of the lab to a separate storage area if desired.



Engineering Science Storage Unit (EST) and experiment kits

## Ordering

For new users the minimum requirement is one work panel (ES1) and one experiment kit.



Dependent on the range of experiments you require, and your budget, additional kits and work panels can be ordered at any time and added to your lab.

## Engineering Science Full Set (ESF)

A complete class set of kits in the storage unit is available consisting of:

- All 18 experiment kits (ES2–ES19)
- Three work panels (ES1)
- A common spare parts kit (ESX)
- Five additional empty storage trays and lids

See page 28



## Engineering Science Specialty Sets:

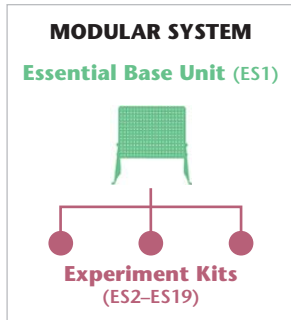
Ours sets are a tailored selection of experiments and work panels focusing on specific topic areas, offered at a special price:

The sets focus on:

- **Forces and moments**  
(Forces Kit, Moments Kit, 2 Works Panels)
- **Materials testing**  
(Deflection of Beams Kit, Torsion of Circular Sections Kit, Tensile Tester Kit, Spring Tester Kit, 4 Work Panels)
- **Simple machines**  
(Pulley Kit, Drive Systems Kit, Gear Trains Kit, Centrifugal Force Kit, 4 Work Panels)
- **Mechanisms**  
(Cam Crank and Toggle Kit, Simple Mechanisms Kit, Bar Linkages Kit, Additional Mechanisms Kit, 4 Work Panels)
- **Vibration, friction and energy**  
(Simple Harmonic Motion Kit, Friction and Inclined Plane Kit, Potential and Kinetic Energy Kit, Rotational Friction Kit, 4 Work Panels)

## Work Panel (ES1)

Multiposition work panel for use with TecQuipment's Engineering Science kits



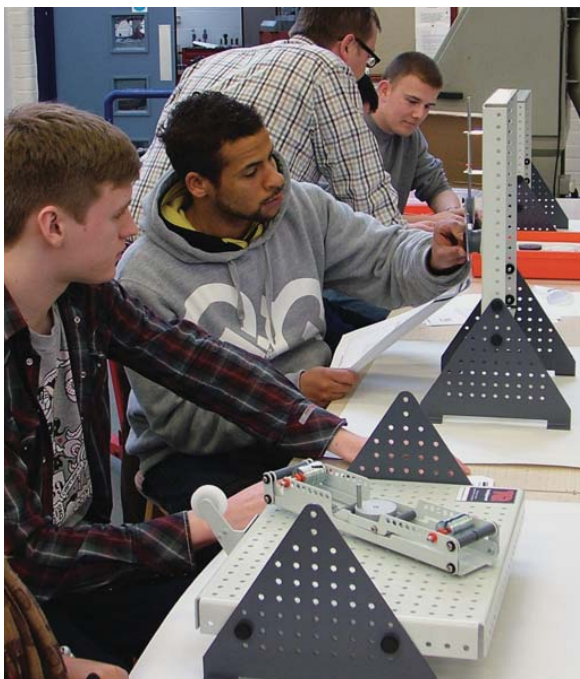
- Perfect size for both experiments and simple classroom demonstrations
- Supplied with CD-ROM of all teaching material needed for the full Engineering Science range
- Stable and multipositional – can be used in many different ways to suit the experiments or demonstrations
- Solid, thick perforated metal plate for long life and choice of fixing positions for the experiments
- Simple thumbscrews for safe, quick and easy assembly



For use with TecQuipment's Engineering Science kits, the work panel fits on any standard desk or bench top. Students, teachers or lecturers fit the parts of their kit to the Work Panel (ES1) to study or demonstrate an engineering science topic.

The work panel has its main panel and two supports. All are made from thick perforated metal to allow students, teachers or lecturers to fit the parts of the kits and the work panel in any position suitable for the experiments.

TecQuipment supplies a CD-ROM with the work panel. This valuable resource includes reproducible worksheets, guidance notes and lecturer notes (with answers) needed for typical experiments with each kit. The selection of parts in the kits and the choice of fixing points on the work panel means that teachers or lecturers may extend the experiments to an even greater range.



Available Experiment Kits:	Page
• Forces Kit (ES2)	10
• Moments Kit (ES3)	11
• Deflection of Beams Kit (ES4)	12
• Torsion of Circular Sections Kit (ES5)	13
• Tensile Tester Kit (ES6)	14
• Simple Harmonic Motion Kit (ES7)	15
• Friction and Inclined Plane Kit (ES8)	16
• Potential and Kinetic Energy Kit (ES9)	17
• Pulley Kit (ES10)	18
• Drive Systems Kit (ES11)	19
• Cam, Crank and Toggle Kit (ES12)	20
• Gear Trains Kit (ES13)	21
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• Additional Mechanisms Kit (ES18)	26
• Spring Tester Kit (ES19)	27

## Forces Kit (ES2)

Shows how to find the centre of gravity of shapes and the relationship between angles and coplanar forces



### EXPERIMENTS:

- Centres of gravity
- Force triangles
- Force polygons and Bow's Notation
- Linked polygons (non-concurrent forces)

This versatile kit is part of a series that allows many experiments using different arrangements of their parts. Students, teachers or lecturers fit the parts of the kit to the Work Panel (ES1, supplied separately) to study or show an engineering science topic.

This kit includes a set of different plastic shapes for experiments in centres of gravity of two-dimensional objects. It also includes pulleys, weights and a magnetic protractor for experiments in concurrent and non-concurrent coplanar forces and angles.

The selection of pulleys and weights allows you to create force triangles, polygons and linked polygons. The guidance notes show how to analyse and predict forces using Bow's Notation and the parallelogram of forces.

TecQuipment supplies a CD-ROM with the Work Panel (ES1). It includes all the worksheets, guidance notes and lecturer notes (with answers) needed for typical experiments with each kit. The selection of parts in the kits and the choice of fixing points on the work panel means that teachers or lecturers may extend the experiments to an even greater range.

**Note:** The kit is for use with the ES1 Work Panel (supplied separately).

### Essential Base Unit:

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- Work Panel (ES1)

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### Alternative Product:

Page

- Equilibrium of Forces (STF4)

193

## Moments Kit (ES3)

Shows the relationship between distances and forces in rigid beams and levers



### EXPERIMENTS:

- Principle of moments
- Beam balances
- 1st, 2nd and 3rd order levers
- Bell crank lever
- Beam reactions

This versatile kit is part of a series that allows many experiments using different arrangements of their parts. Students, teachers or lecturers fit the parts of the kit to the Work Panel (ES1, supplied separately) to study or show an engineering science topic.

This kit includes a rigid beam for experiments in the principle of moments, extending to levers and beams. It shows the three main lever types (1st, 2nd and 3rd order) and includes an 'L' shape plate for experiments in bell crank levers. A pulley allows extra experiments with moments caused by oblique forces.

The rigid beam allows experiments that show the use of moments to find unknown weights, creating simple beam

balances. It also works with spring balances to show reaction forces on beams with point loads and uniformly distributed loads (UDLs).

TecEquipment supplies a CD-ROM with the Work Panel (ES1). It includes all the worksheets, guidance notes and lecturer notes (with answers) needed for typical experiments with each kit. The selection of parts in the kits and the choice of fixing points on the work panel means that teachers or lecturers may extend the experiments to an even greater range.

**Note:** The kit is for use with the ES1 Work Panel (supplied separately).

#### Essential Base Unit: Page

- Work Panel (ES1) 9

#### Alternative Product: Page

- Equilibrium of a Beam (STF5) 193

## Need more information?

For the latest news, updates and product information visit our website at:

[www.tecequipment.com](http://www.tecequipment.com)

## Deflection of Beams and Cantilevers Kit (ES4)

Shows the deflection of beams of different material and dimensions, held on different supports



### EXPERIMENTS:

- Beam length and deflection
- Beam material and deflection (Young's Modulus)
- Beam 'I' value and deflection
- Beam supports (cantilever, propped cantilever, fixed beam and simply supported) and deflection

This versatile kit is part of a series that allows many experiments using different arrangements of their parts. Students, teachers or lecturers fit the parts of the kit to the Work Panel (ES1, supplied separately) to study or show an engineering science topic.

This kit includes different beams and fixing blocks. The fixing blocks work as clamps or knife-edge supports. They hold the beams in different ways, such as a cantilever, simply supported, fixed (encastre) and a propped cantilever.

Students set up a beam on the supports and add weights to deflect the beams. An accurate dial indicator measures the deflection at the point of loading.

The choice of different beams allow extra experiments, showing the relationships between beam deflection and 'I' (second moment of area) value. They also allow comparisons of different beam material and how it affects deflection, introducing Young's Modulus.

Students also use the cantilever for easy experiments showing the relationship between beam length and deflection.

TecEquipment supplies a CD-ROM with the Work Panel (ES1). It includes all the worksheets, guidance notes and lecturer notes (with answers) needed for typical experiments with each kit. The selection of parts in the kits and the choice of fixing points on the work panel means that teachers or lecturers may extend the experiments to an even greater range.

**Note:** The kit is for use with the ES1 Work Panel (supplied separately).

### Essential Base Unit: Page

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| • Work Panel (ES1) | 9 |
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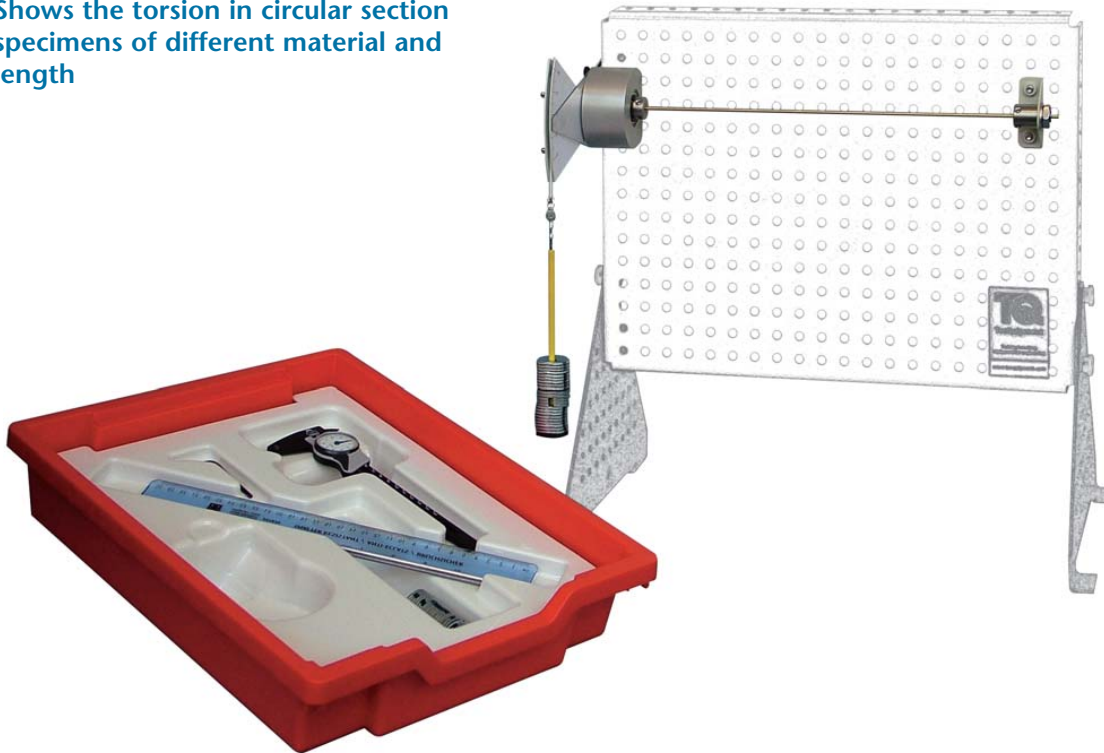
### Alternative Products: Page

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| • Stiffness of Materials and Structures (TE16) | 156 |
| • Beam and Leaf Spring (SM1000g)               | 172 |
| • Beam Apparatus (SM1004)                      | 178 |
| • Deflection of Beams and Cantilevers (STR4)   | 203 |
| • Continuous and Indeterminate Beams (STR13)   | 212 |



## Torsion of Circular Sections Kit (ES5)

Shows the torsion in circular section specimens of different material and length



### EXPERIMENTS:

- Specimen length and angle of twist
- Specimen material and angle of twist (Modulus of Rigidity)
- Specimen 'J' value and angle of twist

This versatile kit is part of a series that allows many experiments using different arrangements of their parts. Students, teachers or lecturers fit the parts of the kit to the Work Panel (ES1, supplied separately) to study or show an engineering science topic.

This kit includes different circular section specimens and adjustable chucks for experiments in torsion.

Students fix the specimens in the chucks and apply weights to a lever arm. The arm applies a moment (torque) to one end of the specimen. A scale on the arm shows the angle of twist.

Standard tests show the relationship between torsion and 'J' (polar second moment of area) value. Students use this to predict the twist angle for any given specimen.

The choice of different specimens allows comparisons of different specimen material and how it affects torsion, introducing the Modulus of Rigidity.

Students also move the chuck positions for easy experiments showing the relationship between specimen length and angle of twist.

TecEquipment supplies a CD-ROM with the Work Panel (ES1). It includes all the worksheets, guidance notes and lecturer notes (with answers) needed for typical experiments with each kit. The selection of parts in the kits and the choice of fixing points on the work panel means that teachers or lecturers may extend the experiments to an even greater range.

**Note:** The kit is for use with the ES1 Work Panel (supplied separately).

### Essential Base Unit:

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- Work Panel (ES1) 9

### Alternative Products:

Page

- Torsion Testing Machine – 30 Nm (SM1001) 164
- Torsion of Circular Sections (STR6) 205
- Torsion Testing Components (TE16b) 156

## Tensile Tester Kit (ES6)

Shows the principles of tensile tests on specimens of different material



### EXPERIMENTS:

- Tensile tests (to destruction) of different materials
- Finding the tensile strength of a material
- Material behaviour in the elastic and plastic region
- Creating a force and extension chart

This versatile kit is part of a series that allows many experiments using different arrangements of their parts. Students, teachers or lecturers fit the parts of the kit to the Work Panel (ES1, supplied separately) to study or show an engineering science topic.

This kit includes specimens of different materials to show students the principles of tensile tests.

Students use the tensile tester to stretch the specimens to destruction, while measuring the extension and force. The tests introduce students to tensile test terms including:

- Overall stress and strain
- Yield properties
- Tensile strength
- Elongation

The choice of different specimens allows comparisons of different specimen material and how it affects its tensile properties.

TecEquipment supplies a CD-ROM with the Work Panel (ES1). It includes all the worksheets, guidance notes and lecturer notes (with answers) needed for typical experiments with each kit. The selection of parts in the kits and the choice of fixing points on the Work Panel means that teachers or lecturers may extend the experiments to an even greater range.

**Note:** The kit is for use with the ES1 Work Panel (supplied separately).

### Essential Base Unit: Page

- Work Panel (ES1) 9

### Recommended Ancillary: Page

- Tensile Test Specimens (MTT) 30

### Alternative Products: Page

- Universal Testing Machine (SM1000) 169
- Bench-top Tensile Testing Machine (SM1002) 167
- Materials Laboratory with Data Capture (MF40) 173

## Simple Harmonic Motion Kit (ES7)

Shows simple harmonic motion (oscillation) in springs and pendulums, and its usefulness



### EXPERIMENTS:

- Simple harmonic motion of simple, bifilar and trifilar pendulums of different length and mass
- Simple harmonic motion of a spring with different masses, and a simple spring rate test
- Simple harmonic motion of a compound pendulum
- Simple harmonic motion and gravity using a Kater's pendulum

This versatile kit is part of a series that allows many experiments using different arrangements of their parts. Students, teachers or lecturers fit the parts of the kit to the Work Panel (ES1, supplied separately) to study or show an engineering science topic.

This kit includes different pendulums and a spring to show students the principles and use of simple harmonic motion. Students test different pendulums and a spring to see how different factors, such as mass or pendulum length, affect simple harmonic motion and the period of oscillation. The theory shows how to predict the period of oscillation for a given pendulum or spring for comparison with actual results. The kit includes an experiment with the Kater's pendulum

that shows the relationship between simple harmonic motion and gravity, for prediction of gravity to a reasonable accuracy.

The kit also introduces students to a simple 'spring rate' test, and key scientific terms such as:

- Moments of inertia
- Parallel axis theorem

TecQuipment supplies a CD-ROM with the Work Panel (ES1). It includes all the worksheets, guidance notes and lecturer notes (with answers) needed for typical experiments with each kit. The selection of parts in the kits and the choice of fixing points on the Work Panel means that teachers or lecturers may extend the experiments to an even greater range.

**Note:** The kit is for use with the ES1 Work Panel (supplied separately).

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### Alternative Products:

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| • Simple and Compound Pendulums (TM161) | 238 |
| • Filar Pendulums (TM162)               | 239 |

## Friction and Inclined Plane Kit (ES8)

Shows the frictional and other forces on bodies and between different surfaces on a flat or inclined plane



### EXPERIMENTS:

- Forces on an inclined plane
- Rolling and sliding friction on different surfaces
- Kinetic and static sliding friction between different surfaces
- Surface angle and friction between different surfaces

This versatile kit is part of a series that allows many experiments using different arrangements of their parts. Students, teachers or lecturers fit the parts of the kit to the Work Panel (ES1, supplied separately) to study or show an engineering science topic.

This kit includes parts for experiments in friction and forces on a flat or inclined plane. The plane has an inclinometer and adjustment to allow the student to set the plane to any angle between zero and 90 degrees. The parts include different friction surfaces, a roller set, a rolling car or sled with adjustable mass, and a simple roller.

Students fit the different parts to the plane and apply masses. They learn how different surface finishes and mass

affect friction and how surface angles and mass affect forces around a body on a plane.

The experiments introduce students to important engineering and scientific terms, such as the coefficient of friction, sliding friction and kinetic friction.

The inclinable plane allows students to do the classic 'forces on an inclined plane' experiments. It also shows the relationship between frictional forces and angles other than horizontal.

TecQuipment supplies a CD-ROM with the Work Panel (ES1). It includes all the worksheets, guidance notes and lecturer notes (with answers) needed for typical experiments with each kit. The selection of parts in the kits and the choice of fixing points on the work panel means that teachers or lecturers may extend the experiments to an even greater range.

**Note:** The kit is for use with the ES1 Work Panel (supplied separately).

### Essential Base Unit:

- Work Panel (ES1)

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# Potential and Kinetic Energy Kit (ES9)

Shows the difference between potential and kinetic energy and how it can change from one to the other



## EXPERIMENTS:

- Kinetic and potential energy in a pendulum
- Elastic potential energy in a spring
- Kinetic energy in a flywheel

This versatile kit is part of a series that allows many experiments using different arrangements of their parts. Students, teachers or lecturers fit the parts of the kit to the Work Panel (ES1, supplied separately) to study or show an engineering science topic.

This kit includes a pendulum, a spring and a flywheel for experiments in potential and kinetic energy.

Students test each part to discover the difference between potential and kinetic energy and the transfer of energy from one form to another.

The kit introduces students to key engineering terms such as 'moment of inertia' and 'elastic potential energy'.

TecQuipment supplies a CD-ROM with the Work Panel (ES1). It includes all the worksheets, guidance notes and lecturer notes (with answers) needed for typical experiments with each kit. The selection of parts in the kits and the choice of fixing points on the Work Panel means that teachers or lecturers may extend the experiments to an even greater range.

**Note:** The kit is for use with the ES1 Work Panel (supplied separately).

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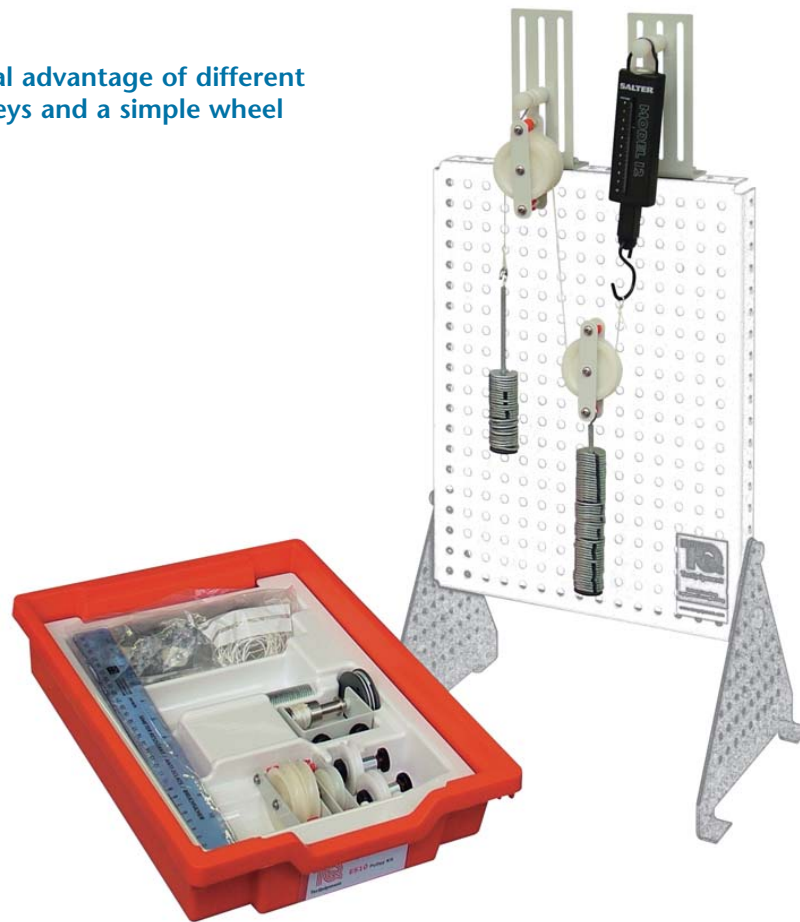
### Alternative Product:

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| • Geared Systems Test Stand (TM1018a) | 231 |
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## Pulley Kit (ES10)

Shows the mechanical advantage of different combinations of pulleys and a simple wheel and axle



### EXPERIMENTS:

- Simple pulleys – fixed, movable and compound
- The wheel and axle
- The Weston differential pulley

This versatile kit is part of a series that allows many experiments using different arrangements of their parts. Students, teachers or lecturers fit the parts of the kit to the Work Panel (ES1, supplied separately) to study or show an engineering science topic.

This kit includes a wheel and axle with single, double and triple wheel or 'sheave' pulleys for experiments in mechanical advantage.

Students test fixed, movable and compound pulleys attached to load and effort weights to test their mechanical advantage.

The kit includes a unique pulley – the Weston Differential pulley – to show how two different sized sheaves on one pulley has a dramatic effect on mechanical advantage.

The kit introduces students to key engineering terms such as machine efficiency, velocity ratio and 'work done'.

TecEquipment supplies a CD-ROM with the Work Panel (ES1). It includes all the worksheets, guidance notes and lecturer notes (with answers) needed for typical experiments with each kit. The selection of parts in the kits and the choice of fixing points on the Work Panel means that teachers or lecturers may extend the experiments to an even greater range.

**Note:** The kit is for use with the ES1 Work Panel (supplied separately).

### Essential Base Unit:

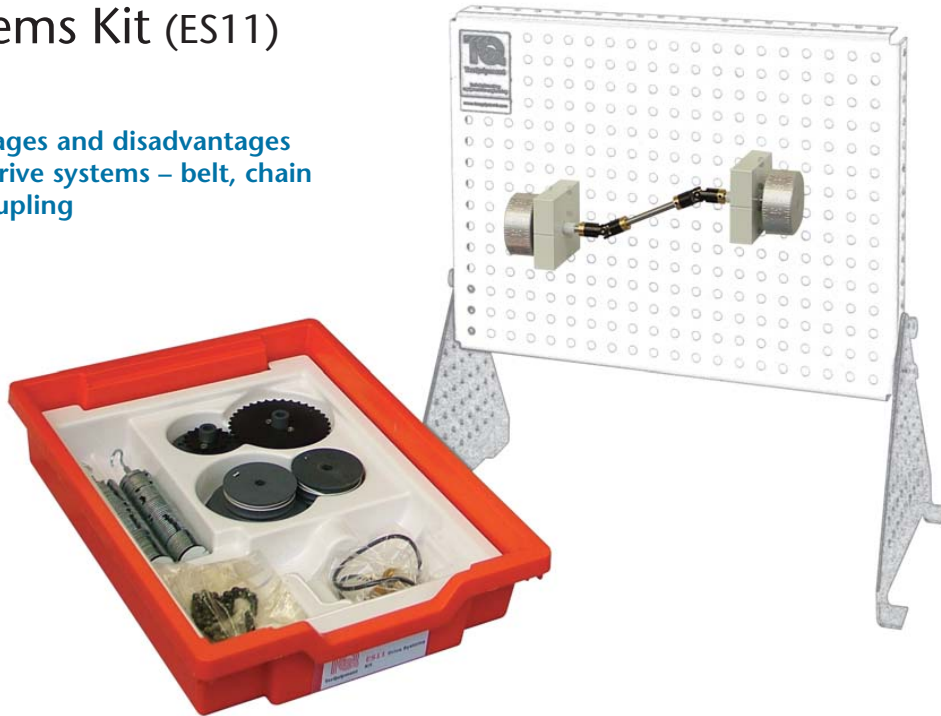
- Work Panel (ES1)

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## Drive Systems Kit (ES11)

Shows the advantages and disadvantages of three popular drive systems – belt, chain and a universal coupling



### EXPERIMENTS:

- Power transfer, efficiency and direction in a belt drive
- Power transfer and efficiency in a chain drive
- Input and output relationships of a universal coupling
- Friction and angle of lap on a pulley

This versatile kit is part of a series that allows many experiments using different arrangements of their parts. Students, teachers or lecturers fit the parts of the kit to the Work Panel (ES1, supplied separately) to study or show an engineering science topic.

This kit includes three different drive systems to show their relative advantages and disadvantages.

Students test a universal coupling, a belt drive and a chain drive to see how they work and how they differ in the way they transfer motion (power).

The kit includes extra parts to help show the importance of the angle of lap around a pulley and its relationship with friction.

The kit introduces students to key engineering terms such as gear ratio, pulley ratio and efficiency.

TecEquipment supplies a CD-ROM with the Work Panel (ES1). It includes all the worksheets, guidance notes and lecturer notes (with answers) needed for typical experiments with each kit. The selection of parts in the kits and the choice of fixing points on the Work Panel means that teachers or lecturers may extend the experiments to an even greater range.

**Note:** The kit is for use with the ES1 Work Panel (supplied separately).

#### Essential Base Unit: Page

- Work Panel (ES1) 9

#### Alternative Product: Page

- Geared Systems (TM1018) 230

## Product development

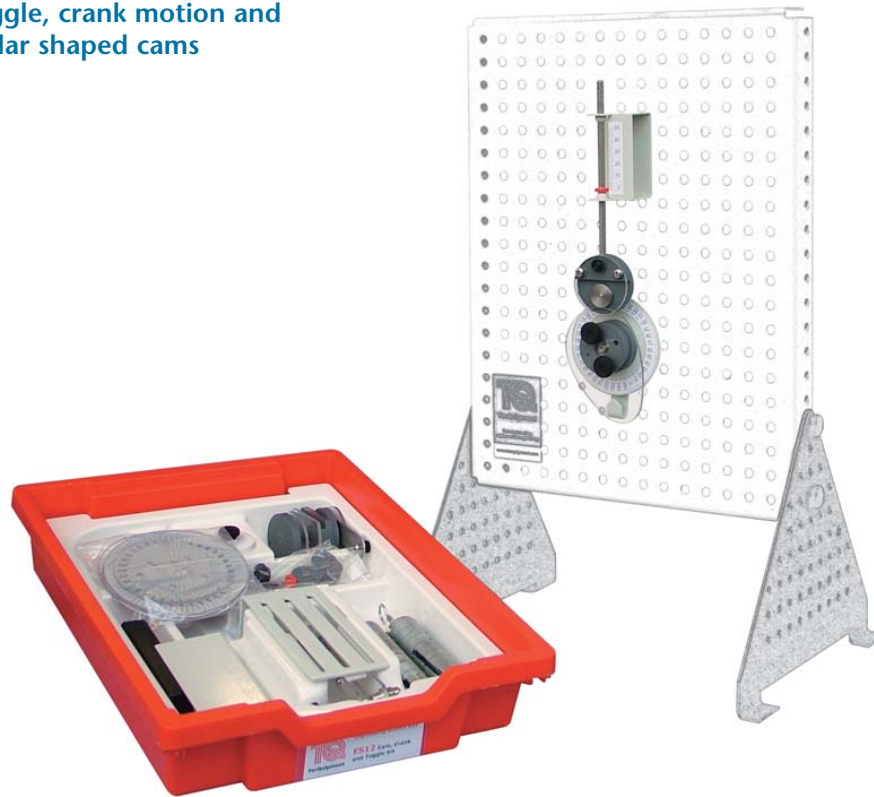
The information contained in this publication has been carefully prepared and is correct at the time of printing. TecEquipment, however, operates a continual product improvement process and therefore reserves the right to modify and update equipment to ensure it continues to meet your needs.

For the latest information on all our products please visit our website at:

[www.tecequipment.com](http://www.tecequipment.com)

## Cam, Crank and Toggle Kit (ES12)

Shows the characteristics of a mechanical toggle, crank motion and the most popular shaped cams



### EXPERIMENTS:

- Displacement and angle characteristics of pear, heart, round and spiral cams
- Characteristics of a mechanical toggle
- Turning moments and forces during crank motion

This versatile kit is part of a series that allows many experiments using different arrangements of their parts. Students, teachers or lecturers fit the parts of the kit to the Work Panel (ES1, supplied separately) to study or show an engineering science topic.

This kit includes a crank and slider to show the relative forces during crank motion. It also includes four popular cam shapes to show their different characteristics. Another set of parts in the kit shows the characteristics of a mechanical toggle.

Students fit the crank and slider with weights and a spring balance to see the change in linear and rotational forces (moments) as the crank turns. They also use the slider with different followers on a set of four popular shaped cams: heart, pear, spiral and round. This gives several cam and follower combinations to help students understand the different characteristics of each cam and why engineers choose between them for different applications.

The last set of parts in the kit has a simple linkage that allows students to see the characteristics of a toggle mechanism. It shows the relative forces and angular conditions of the toggle in its initial state and how they affect the point at which it locks or 'snaps' into a horizontal state.

The kit introduces students to key engineering terms such as a 'flat follower', a 'roller follower' and 'toggle action'.

TecQuipment supplies a CD-ROM with the Work Panel (ES1). It includes all the worksheets, guidance notes and lecturer notes (with answers) needed for typical experiments with each kit. The selection of parts in the kits and the choice of fixing points on the Work Panel means that teachers or lecturers may extend the experiments to an even greater range.

**Note:** The kit is for use with the ES1 Work Panel (supplied separately).

### Essential Base Unit: Page

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### Alternative Product: Page

- Cam Analysis Machine (TM1021) 227



## Gear Trains Kit (ES13)

Shows the characteristics of the most popular gear sets



### EXPERIMENTS:

- Characteristics of spur gears, including single and compound gear trains and the 'idler' gear
- Characteristics of a bevel gear
- Characteristics of a worm drive

This versatile kit is part of a series that allows many experiments using different arrangements of their parts. Students, teachers or lecturers fit the parts of the kit to the Work Panel (ES1, supplied separately) to study or show an engineering science topic.

This kit includes a selection of different gears for experiments to find their unique characteristics.

The gears include spur gears, a bevel gear and a worm drive. The spur gears have two sets of teeth on the same shaft, allowing extra experiments in compound gear trains.

Students test each set of gears to see how it works and note the differences in characteristics (such as efficiency, gear ratio and mechanical advantage) of each set.

The gear sets are a selection of the most common sets, similar to those used in real applications such as automobile gear boxes, domestic and industrial hand tools and clockwork instruments. Each has advantages and disadvantages that make them suitable for a particular job.

The kit introduces students to key engineering terms such as gear ratio, efficiency, mechanical advantage and velocity ratio.

TecEquipment supplies a CD-ROM with the Work Panel (ES1). It includes all the worksheets, guidance notes and lecturer notes (with answers) needed for typical experiments with each kit. The selection of parts in the kits and the choice of fixing points on the work panel means that teachers or lecturers may extend the experiments to an even greater range.

**Note:** The kit is for use with the ES1 Work Panel (supplied separately).

### Essential Base Unit:

Page

- Work Panel (ES1)

9

### Alternative Product:

Page

- Geared Systems (TM1018)

230

## Simple Mechanisms Kit (ES14)

Shows how three popular mechanisms convert motion



### EXPERIMENTS:

- Conversion of motion using the 'Scotch yoke' (or 'slotted link')
- Conversion of motion using the quick return mechanism
- Conversion of motion using the crank and slider

This versatile kit is part of a series that allows many experiments using different arrangements of their parts. Students, teachers or lecturers fit the parts of the kit to the Work Panel (ES1, supplied separately) to study or show an engineering science topic.

This kit includes three popular mechanisms for experiments in conversion of motion from linear to rotary or rotary to linear. These include the Scotch yoke (sometimes called 'donkey crosshead' or 'slotted link'), the crank and slider, and the quick return mechanisms.

Students test each mechanism to see how it works and note the differences in the way that each mechanism converts the motion.

The three mechanisms are the same as those used in real applications, such as combustion engines, power-assisted valves or fluid pumping systems. Each has a unique way of converting motion, shown by the experiments.

The kit introduces students to key engineering terms such as reciprocating motion, rotary to linear motion and linear to rotary motion.

TecQuipment supplies a CD-ROM with the Work Panel (ES1). It includes all the worksheets, guidance notes and lecturer notes (with answers) needed for typical experiments with each kit. The selection of parts in the kits and the choice of fixing points on the work panel means that teachers or lecturers may extend the experiments to an even greater range.

**Note:** the kit is for use with the ES1 Work Panel (supplied separately).

### Essential Base Unit:

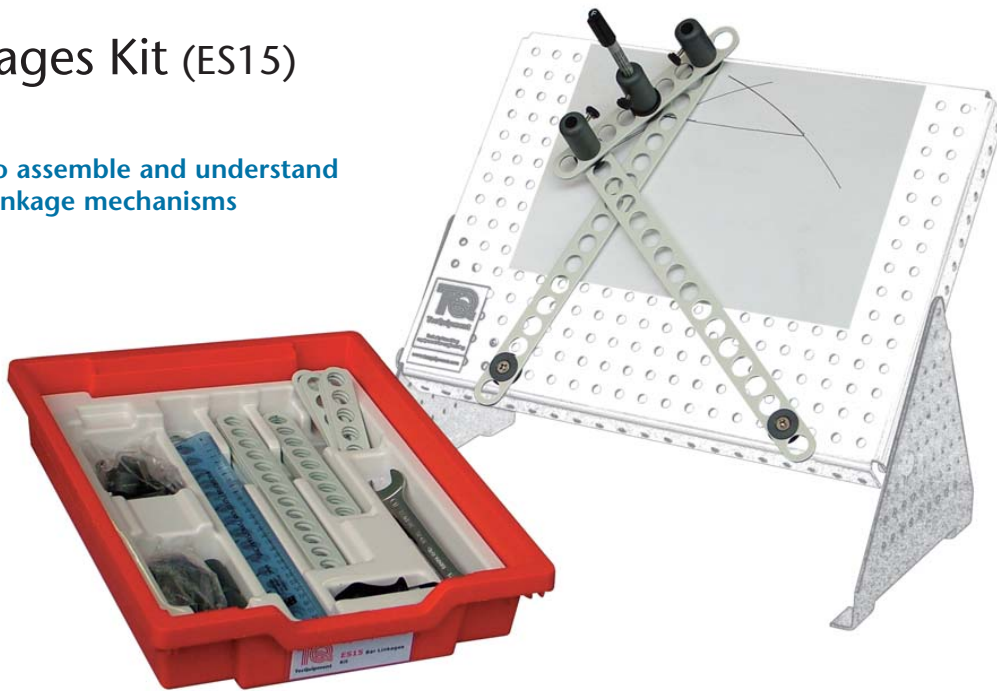
- Work Panel (ES1)

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## Bar Linkages Kit (ES15)

For students to assemble and understand different bar linkage mechanisms



### EXPERIMENTS:

- Four-bar linkages – crank rocker, double rocker, draglink and parallelogram
- Straight line linkages – Watt's straight line, Chebyshev, Peaucellier-Lipkin, Hart's inversor, Robert's and Hoeken's
- Pantograph
- Ackermann steering

This versatile kit is part of a series that allows many experiments using different arrangements of their parts. Students, teachers or lecturers fit the parts of the kit to the Work Panel (ES1, supplied separately) to study or show an engineering science topic.

This kit includes a selection of over 20 perforated bars of different lengths and pivots or 'joints' to allow students to create an unlimited choice of linkages.

Students assemble the bars and joints in any arrangement

and note how the linkage converts movement from one form to another (for example: rotary motion to linear motion). Bar linkages are one of the most basic mechanisms used in mechanical engineering.

The kit includes magnetic 'wipeable' sheets and holders for non-permanent markers so the student can trace the relative movements of the linkages or joints.

The kit introduces students to key engineering terms such as four-bar linkages, rotary and linear movement, and planar linkages.

TecQuipment supplies a CD-ROM with the Work Panel (ES1). It includes all the worksheets, guidance notes and lecturer notes (with answers) needed for typical experiments with each kit. The selection of parts in the kits and the choice of fixing points on the Work Panel means that teachers or lecturers may extend the experiments to an even greater range.

**Note:** The kit is for use with the ES1 Work Panel (supplied separately).

### Essential Base Unit:

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- Work Panel (ES1)

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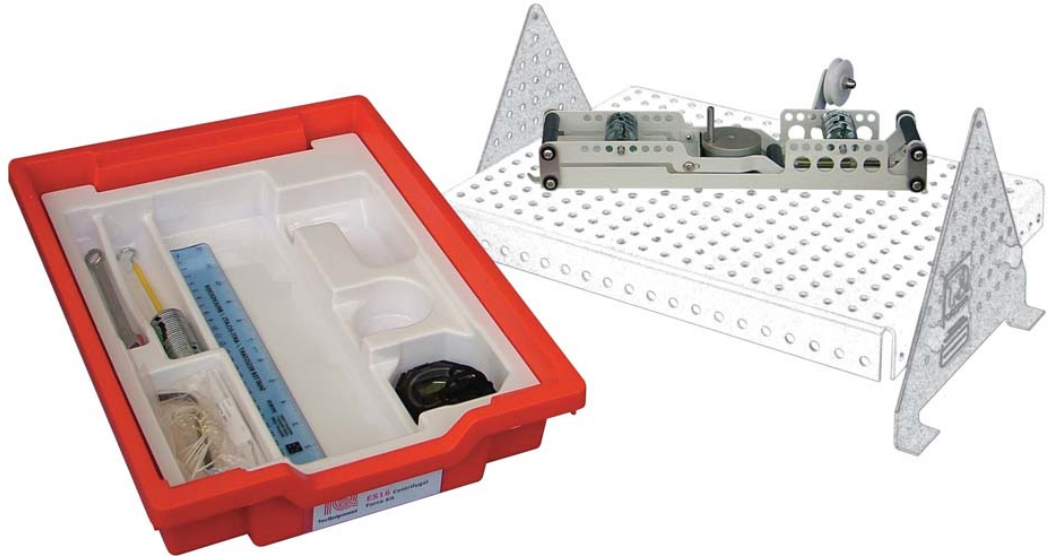
## Products precision-engineered and checked for quality

All the products we manufacture and processes we use are checked, tested and audited to ensure they are of the highest quality.



# Centrifugal Force Kit (ES16)

Shows the relationship between centripetal force, radius and velocity of rotating masses



## EXPERIMENTS:

- Relationship between centripetal force, radius and velocity of different rotating masses.

This versatile kit is part of a series that allows many experiments using different arrangements of their parts. Students, teachers or lecturers fit the parts of the kit to the Work Panel (ES1, supplied separately) to study or show an engineering science topic.

This kit includes a manually rotated frame with a low-friction cantilever linkage. The frame has mounting positions for adjustable masses and a spring that applies a fixed frictional force value to a rotating drum. The range of mounting positions and masses allows many variations of the experiment to help students understand the relationships between the variables of speed, mass and radial position.

Students fit the chosen masses to one side of the frame and an equal counterbalance to the opposite side of the frame. They rotate the assembly which will overcome the spring frictional force at a given speed, working as a centrifugal clutch that regulates its own speed. The frame has a durable 'clicking' tab that students use with a stopwatch (supplied)

to measure the speed. They use their measurements to calculate the forces due to the rotating masses and compare them with the opposing force from the spring.

The kit introduces students to key engineering terms such as centrifugal and centripetal force, while explaining the fictitious term 'centrifugal' force and its accepted use. It also shows the use of 'radians' in rotational velocity measurement.

TecQuipment supplies a CD-ROM with the Work Panel (ES1). It includes all the worksheets, guidance notes and lecturer notes (with answers) needed for typical experiments with each kit. The selection of parts in the kits and the choice of fixing points on the Work Panel means that teachers or lecturers may extend the experiments to an even greater range.

**Note:** The kit is for use with the ES1 Work Panel (supplied separately).

### Essential Base Unit: Page

- Work Panel (ES1) 9

### Alternative Product: Page

- Centrifugal Force (TM1005) 235

## Rotational Friction Kit (ES17)

Shows how rotational friction affects the efficiency of popular machine elements



### EXPERIMENTS:

- Efficiency of a screw jack
- Efficiency of a wedge
- Efficiency of different bearings

This versatile kit is part of a series that allows many experiments using different arrangements of their parts. Students, teachers or lecturers fit the parts of the kit to the Work Panel (ES1, supplied separately) to study or show an engineering science topic.

This kit includes a screw jack (or 'jackscrew'), a wedge and different bearings. It helps students understand how rotational friction affects the efficiency of popular machine elements and bearing materials. It shows why engineers choose some materials and devices above others for any given application.

Students fit the parts to the work panel and apply effort and load weights to find their relative mechanical advantage and efficiency.

The kit introduces students to key engineering terms such as:

- Mechanical advantage
- Velocity ratio
- Efficiency
- 'Overhaul'

TecEquipment supplies a CD-ROM with the Work Panel (ES1). It includes all the worksheets, guidance notes and lecturer notes (with answers) needed for typical experiments with each kit. The selection of parts in the kits and the choice of fixing points on the Work Panel means that teachers or lecturers may extend the experiments to an even greater range.

**Note:** The kit is for use with the ES1 Work Panel (supplied separately).

### Essential Base Unit:

- Work Panel (ES1)

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# Additional Mechanisms Kit (ES18)

Shows how two popular mechanisms convert motion



### EXPERIMENTS:

- Conversion of motion using the Geneva mechanism
- Conversion of motion using a ratchet

This kit offers additional mechanisms, supplementary to those of the Simple Mechanisms Kit (ES14). Students, teachers or lecturers fit the parts of the kit to the Work Panel (ES1, supplied separately) to study or demonstrate an engineering science topic.

This kit includes two popular mechanisms for experiments in conversion of motion from one form to another. These include the Geneva mechanism (sometimes called the Maltese Cross mechanism or crank and star), and a ratchet mechanism.

Students test each mechanism to see how it works and note the differences in the way that each mechanism converts the motion.

The two mechanisms are the same as those used in real applications, such as CNC machines, hand tools, turnstiles and lifting hoists. Each has a unique way of converting motion, shown by the experiments.

TecQuipment supplies a CD-ROM with the Work Panel (ES1). It includes all the worksheets, guidance notes and lecturer notes (with answers) needed for typical experiments with each kit. The selection of parts in the kits and the choice of fixing points on the work panel means that teachers or lecturers may extend the experiments to an even greater range.

**Note:** The kit is for use with the ES1 Work Panel (supplied separately).

### Essential Base Unit:

- Work Panel (ES1)

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## Standard features for all our products:



Supplied with comprehensive user guide



Five-year warranty



Manufactured in accordance with the latest European Union directives

# Spring Tester Kit (ES19)

Shows the characteristics of coiled springs and how to test them



## EXPERIMENTS:

- Hooke's Law and compression spring tests
- Hooke's Law and extension spring tests
- Parallel and series spring tests

This versatile kit allows many experiments using different arrangements of its parts. Students, teachers or lecturers fit the parts of the kit to the Work Panel (ES1, supplied separately) to study or demonstrate an engineering science topic.

This kit includes different coiled springs for experiments in spring testing. These include extension springs, compression springs, parallel springs and springs that can connect in series.

Students test the springs to prove Hooke's Law and find their spring rate, comparing it with given manufacturers' values. They also test springs in parallel and series to see how this affects the overall spring rate.

The kit helps students to understand the link between spring rate, spring extension and the design and construction of springs. It introduces students to key engineering terms such as:

- Spring rate
- Hooke's Law
- Spring pretension

TecEquipment supplies a CD-ROM with the Work Panel (ES1). It includes all the worksheets, guidance notes and lecturer notes (with answers) needed for typical experiments with each kit. The selection of parts in the kits and the choice of fixing points on the work panel means that teachers or lecturers may extend the experiments to an even greater range.

**Note:** The kit is for use with the ES1 Work Panel (supplied separately).

### Essential Base Unit:

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| • Work Panel (ES1) | 9 |
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### Alternative Products:

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|------------------------------------|-----|
| • Spring Testing Apparatus (SM110) | 155 |
| • Coil Spring (SM1000f)            | 171 |

# Engineering Science Full Set (ESF)

**A mobile trolley with a complete set of TecEquipment's Engineering Science kits and Work Panels**

- A mobile and compact trolley holding a full set of TecEquipment's Engineering Science kits (ES2 to ES19) and three Work Panels (ES1) for over 60 experiments in fundamental engineering science topics
- All the parts needed in one mobile frame – one person can move a full set of kits from one room to another
- Includes a Spares Kit (ESX) to replace common parts that could become lost from experiments during use
- Spare empty trays to store additional material such as coursework, worksheets or guidance notes
- Strong, lockable wheels on the trolley allow easy movement but also hold the trolley stable when needed – making it an ideal demonstration table
- Flat top with fixing positions for storage of the work panels



A complete package in Engineering Science experiments. The full set (ESF) includes the Engineering Science mobile trolley (EST), a full set of TecEquipment's Engineering Science kits (ES2 to ES19), Work Panels (ES1) and a Spares Kit (ESX).

This full set allows at least three sets of students to work with any three of the Engineering Science experiments at the same time, while storing the other kits tidily and efficiently.

Alternatively, lecturers or teachers may set up one experiment as a demonstration on the mobile trolley while two groups of students do experiments at their desks.

TecEquipment supplies a Spares Kit (ESX) with the package to help replace the common smaller parts of the kits that may get lost over time. The trolley also includes some empty trays, useful for storing coursework, worksheets or guidance notes.

## Experiment kits

- Forces Kit (ES2)
- Moments Kit (ES3)
- Deflection of Beams and Cantilevers Kit (ES4)
- Torsion of Circular Sections Kit (ES5)
- Tensile Tester Kit (ES6)
- Simple Harmonic Motion Kit (ES7)
- Friction and Inclined Plane Kit (ES8)
- Potential and Kinetic Energy Kit (ES9)
- Pulley Kit (ES10)
- Drive Systems Kit (ES11)
- Cam, Crank and Toggle Kit (ES12)
- Gear Trains Kit (ES13)
- Simple Mechanisms Kit (ES14)
- Bar Linkages Kit (ES15)
- Centrifugal Force Kit (ES16)
- Rotational Friction Kit (ES17)
- Additional Mechanisms Kit (ES18)
- Spring Tester Kit (ES19)



# Support Equipment

## Support equipment for use with TecQuipment's Engineering Science range

- Supporting products for TecQuipment's Engineering Science kits
- A set of five spare trays and lids (ETL) – useful for safely storing ancillaries or printed material such as lecturer guides or worksheets
- A compact mobile frame (EST) that stores up to 24 trays safely and tidily, while allowing one person to move all 24 trays from one room to another



Storage Unit (EST)

For use with the Engineering Science kits, TecQuipment offers these supporting products as a useful resource for lecturers or teachers.

### Storage Unit (EST)

A mobile trolley for use with the Engineering Science kits. This trolley allows teachers or lecturers to safely and tidily store up to 24 trays in one mobile unit.

The trolley allows one person to push all the trays from one room to another. It has extra space on top with fixing points so it may also carry or hold Work Panels (ES1).

Its lockable wheels allow it to be both mobile and stable. It allows teachers or lecturers to fit work panels to the top and use the trolley as a mobile demonstration table.

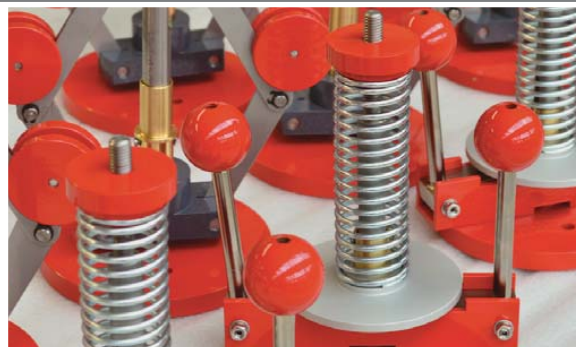
### Trays and Lids (ETL)

A set of five trays and lids. Identical to those used for the kits, so they fit and stack in the same way. These trays and lids are useful to safely store ancillaries, writing materials or A4 size printed material.



## Manufacturing in quantity to improve delivery and prices

We set manufacturing batch sizes to ensure that we can offer both realistic deliveries and competitive prices.



# Spares and Consumables

## Spares and consumables for use with TecQuipment's Engineering Science range

- Spares and consumable products for TecQuipment's Engineering Science kits
- Useful to replace any parts that become lost from the experiment kits during use, or to increase the variation of experiments
- Additional Tensile Test Specimens (MTT) for the Tensile Tester Kit (ES6)
- Additional Weight Sets (WT and WTL) and Stopwatch (SW1) – useful spares for both the Engineering Science range and other TecQuipment products
- A tray of spares (ESX) containing the most common parts of the Engineering Science kits



Spare Parts Kit (ESX)

TecQuipment offers these spares and consumables mainly for the Engineering Science range. However, the stopwatch and weight sets also work as spares for other TecQuipment product ranges.

### Spare Parts Kit (ESX)

This kit includes spares of the most common parts used in the other Engineering Science kits, including fixings, weights, hooks and cord.

Lecturers or teachers may use the spares to replace lost parts or add additional parts to the existing experiments.

The kit reduces the need to order the small parts that may become misplaced during use. It also reduces the problems created by 'borrowing' items from one kit to replace those lost in another kit.

This kit also allows teachers to add more variation to some of the standard experiments suggested by TecQuipment.

### Stopwatch (SW1)

An easy-to-use, accurate, hand-held digital stopwatch. Replaces any lost from the kits or allows more students to share experiments. This general-purpose stopwatch also works well with several other TecQuipment products.



### Tensile Test Specimens (MTT)



Specimens made from a choice of four different materials for use with the Engineering Science Tensile Tester (ES6).

**MTTA** – Aluminium

**MTTD** – Duralumin

**MTTP** – PVC

**MTTS** – Mild Steel

**Note:** TecQuipment supplies all specimens individually, but a minimum order charge applies.

### Weight Sets (WT and )

Slotted masses that fit onto TecQuipment's weight hangers. They will work as general-purpose weights and spares for those in several other TecQuipment products, such as the Structures range.

Useful to replace any that become lost from the Engineering Science kits or to extend the experiments suggested in the worksheets.

**WT** – A set of 10 g masses and weight hangers

**WTL** – A set of 1 g masses

